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EFFECT OF PLANT GROWTH PATTERN, TILLER DYNAMICS AND DRY MATTER ACCUMULATION OF DIRECT SEEDED RICE (*ORYZA SATIVA* L.) BY DIFFERENT MOISTURE REGIMES AND ORGANIC MANURES

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ABSTRACT

All the parameters like number of tillers, leaf area index, dry matter accumulation, spikelets/ panicle, grain yield and straw yield were significantly influenced by the levels of moisture regimes except crop growth rate. The maximum number of tillers (297.89), spikelets/ panicale (97.94) and grain yield (45.98 q ha^{-1}) were found significantly superior in treatment I_1irrigation at 1 Days after disappearance of ponded water (DAD) to treatment I_3 -irrigation at 5 DAD, but was statistically at par with I_2 - irrigation at 3 DAD. In case of organics, all parameters like number of tillers, leaf area index, dry matter accumulation, spikelets/ panicle, grain yield and straw yield were significantly influenced by the organics. The maximum number of tillers (304.02), spikelets/ panicale (104.05) and grain yield (51.60 q ha^{1}) were found significantly superior in treatment F_2- 100 % RDF + Brown manure (BM) to rest of the treatments, but in case of spikelets/ panicalewas statistically at par with F_3-FYM @ 10 t ha^{-1}. But in both treatments harvest index was observed non-significant. So, it may concluded that treatment I_1 – irrigation at 1 DAD and treatment F2- 100% RDF + BM was observed superior to rest of the treatments.

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INTRODUCTION

Rice is leading food crop providing 25 % of world supply of calories and 20 % of proteins. In India rice is grown in both *kharif* and *rabi* season under diverse ecological and climatic conditions apart from socio-economic diversities of the state. In India 33 % of total rice land has got irrigation facilities and rest is totally dependent upon rainfall. Among various depressing factors, moisture and nutrient use is the most crucial factor particularly under direct seeded upland condition due, to which rice production is unpredictable and considerably low.The largest fresh water consumption of more than 75% is for irrigation in the agriculture sector and is mainly confined to irrigated rice production. Irrigated rice is normally grown in a flooded environment during most of its growing period thus, growing rice requires a large amount of water. Rice is a heavy consumer of water but its water-use-efficiency is rather low. It is estimated about 3,500 litres of water is used to produce 1 kg of rice and that the water productivity index (WPI) of rice is 0.3 kg grain/m3 water. Farmers prefer to maintain a relatively high water level during the crop growth period in order to control weeds, as assurance against future water shortages and reduce the frequency of irrigation. Thus, rice will be the crop most affected by the water crisis as it depends mostly on irrigation.Use of higher dose of high analysis fertilizers (containing high amounts of N, P and K only) and insufficient use of organics has created deficiencies of secondary and micronutrients particularly Zn and Fe (Takkar, 1996). The soils are showing signs of fatigue, as judged by decline in the yields of rice as well as a lower response to applied chemical fertilizers (Yadav *et al.*, 1998). Organic farming is referred to the cultivation of crops without addition of synthetic materials. It is generally preferred because it improves the quality of food grain by reducing the cost of cultivation.Conjoint use of fertilizers and manures would not only impart sustenance to the production and improve soil health, but also enhance the efficient use of applied nutrients. (Nayak*et al.* 2015). Application of organic manure not only improves the soil organic carbon for sustaining the soil physical property but also increases the soil nitrogen. However, nitrogen use efficiency is very low particularly in rice and it is difficult to sustain it in the soil system due to volatilization, leaching and denitrification losses. Hence, nitrogen is the element to be given first thrust in sense of organic farming (Magar, 2004).Balanced use of nutrients through organic sources likefarmyard manure, vermicompost, green manuring, neem cake and biofertilizersare prerequisites to sustain soil fertility, to produce maximum crop yield withoptimum input level (S. Alagappan and R.venkitaswamy 2015). The use of organic manures can help to maintain optimum crop yield by maintaining the fertility status of the soil (DivyaSahare, 2015). Keepingall thesethings in view the present investigation was undertaken to effect of plant growth pattern, tiller dynamics and dry matter accumulation of direct seeded rice (*Oryza sativa* L.) by different moisture regimes and organic manures.

MATERIALS AND METHODS

The field experiments were conducted at Crop research centre, Rajendra Agricultural

University, Pusa, Bihar during *kharif* season 2012. The soil of the experimental plot was calcareous alluvium in nature and slightly alkaline in reaction (pH 8.46), low in available N (181.70 kg/ha), P (19.00 kg/ha) and K (96.00 kg/ha). Three moisture regimes based on 1, 3 and 5 DAD (days after disappearance of ponded water) irrigation as main plot and 6 levels of organic manures (100 % recommended dose of fertilizer (RDF) (F_1), 100 % RDF + brown manuring (F_2), 100 % RDF + FYM @ 10 t ha^{-1} (F_3), 100 % RDF + vermi-compost @ 0.75 t ha^{-1} (F4), 100 % RDF + vermi-compost @ 1.5 t ha^{-1} (F5) and 100 % RDF + vermi-compost @ 3 t ha^{-1} (F_6) as sub-plots were tested in a split plot design with three replications. On the basis of nutritive value of vermicompost (VC) and FYM in terms of N, P and K, the amount of chemical fertilizer (RDF) had been adjusted.The gross plot size was 9 m x 3 m. Seeds of cultivar MTU 1010 was sown in line at a spacing of 20 cm row to row. Crop was sown on 29 June, 2012 and harvested on 27 October, 2012. Weedicide 2-4-D was applied at 30 days after sowing in treatment F_2 (100 % RDF + BM) for decomposing of dhaincha. The numbers of tillers per m^2 was counted at harvest. The tagged plants were used for the purpose at different crop growth stages by visual counting. Leaf area index was calculated for rice crop at successive growth stages. The total leaf area was determined by length X maximum width method, the product being multiplied by a correction factor of 0.75 given by Yoshida (1981) for rice. The leaf area data were utilized for determining LAI by the formula as described by Wastson (1952). Plants of 1meter row length above soil surface were taken out from sample rows of plots at harvest for dry weight shoots were sun dried and then kept in electric oven at 700C + 1 till constant weight reached. The observation was finally calculated as dry weight of plants g/m^2. Total number of spikelets of the ten panicles is calculated by adding the numbers of filled, half-filled and empty spikelets per panicle and then the average number of grains per panicle was calculated.Grain yield, straw yield, and harvest index wererecorded at harvest. The straws were sun dried and the yieldof grain and straw/plot were converted to t/ha (Rajbhandari,2007). Collected data were analyzed statistically followingANOVA technique and the mean differences were adjudgedby Duncan's multiple Range lest (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of moisture regimes

The data related to number of tillers, leaf area index, CGR (g/day/m^2), number of spikelets/panicle, straw yield, yield and harvest index were presented in Table 1.

The data on number of tillers, leaf area index, spikelets/panicle, grain yield and straw yieldrevealed that different moisture regimes had significant influence on tillers/m^2, leaf area index, spikelets/panicle, grain yield and straw yieldwhereas, maximum number of tillers/m^2 (297.89), leaf area index (3.39), spikelets/panicle (97.94), grain yield (45.98 q ha^{-1}) and straw yield (59.40 q ha^{-1})in I_1 - irrigation at 1 DAD,which was significantly superior to I_3- irrigation at 5 DAD and were statistically at par with I_2 – irrigation at 3 DAD except leaf area index, in case of leaf area index I_1 - irrigation at 1 DAD recorded significantly higher as compared to both I_2 – irrigation at 3 DAD (3.18) and I_3-irrigation at 5 DAD (2.02). Tillering is an important characteristic of the plant from agronomic point of view. Its role in rice particularly is of crucial importance in which the productive tillers to total tillers ratio is influenced by environmental conditions. Tillers apparently enable the plants to exploit the environment to the full and sufficient numbers of tillers are essential to get higher yield. This consequently resulted in significantly taller plant in case of irrigation at 1 DAD. The results are in conformity with the findings of Choudhary*et al.* (2007), Jayaprakash and Wahab (1995), Singh *et al.* (2000) and Shekara *et al.* (2010).

Data on crop growth rate g/day/m^2 at harvest and harvest index didn't show any significant effect under different moisture regimes.However,maximum crop growth rate was observed under I_1 - irrigation at 1 DAD (7.39 g/day/m^2) andminimum under I_3 - irrigation at 5 DAD (7.02 g/day/m^2).Data on moisture regimes had non-significant influence on harvest index of rice however, maximum harvest index (44.78 %) was recorded with I_3 - irrigation at 5 DAD followed by I_1 - irrigation at 1 DAD

Table 1: Effect of plant growth pattern, yield attributes and yield of direct seeded rice (*Oryza sativa* L.) as influenced by moisture regimes and organic manures

Treatment	No. of tillers/m^2	LAI	CGR (g/m^2/day)	Spikelets/ panicle	Grain yield(q ha^{-1})	Straw yield (q ha^{-1})	Harvest index(%)	WR (cm)
Moisture regimes								
I_1 - irrigation at 1 DAD	297.89	3.39	7.39	97.94	45.98	59.40	43.62	107.54
I_2 - irrigation at 3 DAD	282.64	3.18	7.35	93.37	43.28	56.70	43.16	87.01
I_3- irrigation at 5 DAD	247.31	2.02	7.02	87.88	38.70	47.60	44.78	73.38
SEm+	3.88	0.044	0.13	1.67	0.85	1.013	0.39	-
C.D. (p=0.05)	15.25	0.173	NS	6.57	3.32	3.98	NS	-
Organics								
F_1 - 100 % RDF	264.88	2.41	6.55	87.58	38.96	52.61	42.62	89.39
F_2 - 100 % RDF + BM	304.02	3.27	9.69	104.05	51.60	63.03	45.10	89.34
F_3 - FYM @ 10 t ha^{-1}	274.91	3.16	6.24	93.44	42.13	53.23	44.19	89.22
F_4 - VC @ 0.75 t ha^{-1}	268.08	2.68	6.69	89.52	40.50	52.62	43.48	89.30
F_5 - VC @ 1.50 t ha^{-1}	270.30	2.65	8.38	90.99	40.70	52.69	43.53	89.30
F_6 - VC @ 3.0 t ha^{-1}	273.48	3.03	5.98	92.79	42.03	53.21	44.19	89.28
SEm+	6.45	0.117	0.29	3.30	1.61	1.78	0.54	-
C.D. (P=0.05)	18.69	0.340	0.83	10.29	4.65	5.15	NS	-

and I_3 - irrigation at 3 DAD.Data related with water requirement was computed and embodied in Table 1. The water requirement of rice varied from 107.54 cm to 73.38 cm owing to the use different moisture regimes. The treatment irrigation at 1 DAD (I_1) gave maximum water requirement and treatment irrigation at 5 DAD (I_3) gave minimum water requirement.

Effect of Organic Manure

The data related to number of tillers, leaf area index, CGR (g/day/m^2), number of spikelets/panicle, straw yield, yield and harvest index were presented in Table 1.Maximum value of number of number of tillers (304.02), leaf area index (3.27), CGR (9.69 g/day/m^2), number of spikelets/panicle (104.05), grain yield (51.60 q ha^{-1}), straw yield (63.03 q ha^{-1}) were observed at F_2 - 100 % RDF + BM which was significantly superior over organics F_3 receiving FYM @ 10 t ha^{-1}, F_1 receiving 100 % RDF, F_4 receiving VC @ 0.75 t ha^{-1}, F5 receiving VC @ 1.50 t ha^{-1} and F_6 receiving VC @ 3.0 t ha^{-1}. But in case of leaf area index treatment F_2 - 100 % RDF + BM was at parity with F_3 receiving FYM @ 10 t ha^{-1}and F_6 receiving VC @ 3.0 t ha^{-1}. Harvest index was didn't exert any significant effect but, maximum harvest index was found in F_2 – 100 % RDF + BMand minimum was observed in F_1- 100 % RDF.Dhaincha fix the atmospheric nitrogen by the root nodule and after decomposition of residues supply nitrogen to growing tillers of rice plant has also been reported by Dhyani*et al.* (2009). Majhi*et al.* (2009) reported that after application of 2-4, D there is a decline in the growth of dhaincha and when it is incorporate in the soil its biomass mix up with the soil as a result the fertility status of the soil is enriched. In case of organic manure, increased number of tillers due to slow and steady release of nutrients has also been reported by Ravi and Shrivastava (1997), Barik*et al.* (2006) and Hasanuzzaman*at el.* (2010).Data related with water requirement was computed and embodied in Table 1. The water requirement of rice varied from 89.39 cm to 89.22 cm owing to the use different organics. The application of FYM @ 10 t ha^{-1} (T_3) gave minimum water requirement and treatment 100 % RDF (F_1) gave maximum water requirement.

On the basis of these findings, it can be concluded that to achieve higher productivity 1 days after disappearance of ponded water in direct seeded rice could meet the water requirement and use of different organic manures also help to conserve the moisture in soil. But in case of yield concluded that 100 % RDF + BM (F_2) and I_1 levels of irrigation at 1 day after disappearance of ponded water proved as the best treatment combination.

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